material of known properties could be fastened to the side 45° angular wedge now found in air so that the reflection at this surface can be easily calculated. The reflection at this surface would be less than air, and the reflection at this surface for each echo can be taken into account.

It is also to be understood that another embodiment of the present invention is a unique technique to determine fluid properties wherein an ultrasonic transducer **30** is provided on a surface **42** of a solid member **40** having an opposed second surface **44** in contact with the fluid **25**. A second ultrasonic transducer **31** configured to transmit a shear wave to the interface **23** between the fluid **25** and the material is also provided. This technique can include delivering an ultrasonic pulse through these two transducers **30**, **31** detecting a multiplicity of pulse echoes caused by reflections of the ultrasonic pulse between the solid-fluid interface and the transducer-solid interface, and determining the decay rate of the detected echo amplitude as a function of echo number. The determined decay rate is compared to a calibrated decay rate, such as obtained using water or another calibration fluid, to determine an acoustic property of the fluid. In some applications this includes a reflection coefficient which can be further calculated to obtain a value such as the density of the material or the velocity of sound through the fluid.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes, equivalents, and modifications that come within the scope of the inventions described herein or defined by the following claims are desired to be protected. Any experiments, experimental examples, or experimental results provided herein are intended to be illustrative of the present invention and should not be construed to limit or restrict the invention scope. Further, any theory, mechanism of operation, proof, or finding stated herein is meant to further enhance understanding of the present invention and is not intended to limit the present invention in any way to such theory, mechanism of operation, proof, or finding. In reading the claims, words such as "a", "an", "at least one", and "at least a portion" are not intended to limit the claims to only one item unless specifically stated to the contrary. Further, when the language "at least a portion" and/or "a portion" is used, the claims may include a portion and/or the entire item unless specifically stated to the contrary.

What is claimed is:

1. A method for determining a fluid property comprising the steps of:

delivering a first ultrasound pulse to a member with a transducer, the member being comprised of a solid material and including a first surface opposite a second surface, the first surface being coupled to the transducer and the second surface being in contact with a fluid, the ultrasound pulse reflecting between the first surface and the second surface to provide a first ultrasound pulse echo series;

detecting a multiplicity of the ultrasound pulse echoes of the echo series with the transducer;

delivering a second ultrasound pulse through a shear wave transducer, the shear wave transducer configured to provide a pulse at a general angle of 45 degrees relative to the interface of said second surface and said fluid to obtain a second ultrasound pulse echo series;

detecting a multiplicity of ultrasound pulse echoes of said second ultrasound pulse echo sound series with said shear wave transducer;

determining a first value from the multiplicity of pulse echoes of the first ultrasound pulse echo series;

determining a second value from the multiplicity of pulse echoes of the second ultrasound pulse echo series; and

determining a physical property of the fluid utilizing said first and second values.

2. The method of claim **1** wherein said physical property is selected from the group consisting essentially of velocity, density and combinations thereof.

3. The method of claim **1** wherein said step of determining a physical property comprises comparing measurements of reflection coefficients with a theoretical calculation to extract the density of the material and the velocity of sound in the material.

4. The method of claim **3** wherein the reflection coefficients are obtained by plotting the natural log of the ratio of FFT amplitudes against an echo number and finding the slope of this line.

5. The method of claim **1** wherein the transducer produces the ultrasonic pulse in response to a voltage input from a pulser and wherein the first value is determined by selecting a peak echo amplitude at a predetermined frequency for each of the detected echoes and determining a value corresponding to an average decay rate of the selected peak echo amplitude for each of the multiplicity of ultrasound pulse echoes as a function of echo number.

6. The method of claim **5** wherein the transducer produces an output signal in response to the detecting and the transducer output signal is digitized and transformed from time domain to frequency domain prior to selection of the peak echo amplitude for each of the multiplicity of ultrasound pulse echoes.

7. The method of claim **5** wherein at least two of the multiplicity of ultrasound pulse echoes are detected during the detecting steps.

8. The method of claim **1** wherein the first ultrasonic pulse is a longitudinal wave and the physical property is fluid density.

9. The method of claim **1** wherein the second ultrasonic pulse is a shear wave and the physical property is selected from the group consisting of the velocity of sound, the density of the liquid and combinations thereof.

10. A system for determining a fluid property comprising:

a longitudinal ultrasonic transducer, operably connected to an interface between a solid and a fluid, said longitudinal ultrasonic transducer configured to send and receive ultrasonic transmissions;

a shear wave transducer operably connected at a general angle of 45 degrees to an interface between said solid and said fluid, said shear wave transducer operably configured to send and receive ultrasonic transmissions; and

a computing device configured to receive information from said longitudinal ultrasonic transducer and said shear wave transducer and to perform a preselected program of method steps to determine a preselected value correlating to said fluid property.

11. The system of claim **10** wherein said shear wave transducer is operatively connected at a preselected angle to an angle block made of fused quartz whereby said shear wave transducer transmits an ultrasonic wave at a generally 45 degree angle.

12. A method for determining a fluid property comprising the steps of:

delivering an ultrasound pulse to a member with a transducer, the member being comprised of a solid material and including a first surface opposite a second surface, the first surface being coupled to the transducer and the